FACULDADE DE MEDICINA
UNIVERSIDADE DO PORTO

MESTRADO INTEGRADO EM MEDICINA

2010/2011

Ana Luísa Faceira Valente

Firearm Suicides in the North of Portugal

Abril, 2011

FACULDADE DE MEDICINA
UNIVERSIDADE DO PORTO

Ana Luísa Faceira Valente

Firearm Suicides in the North of Portugal

Mestrado Integrado em Medicina

Área: Medicina Legal

Trabalho efectuado sob a Orientação de:

Professor Doutor Agostinho José Carvalho dos Santos

E Co-Orientação de:

Mestre Lino Alberto Aranda Assunção

Revista científica de referência:

International Journal of Legal Medicine

Abril, 2011

U.PORTO
FMUP FACULDADE DE MEDICINA UNIVERSIDADE DO PORTO

Faculdade de Medicina da Universidade do Porto

2010/2011

Unidade Curricular "Dissertação/Monografia/Relatório de Estágio Profissionalizante"

Projecto de Opção do 6º ano – DECLARAÇÃO DE REPRODUÇÃO

Nome: Ana Luísa Faceira Valente

Endereço electrónico: med05129@med.up.pt **Telefone ou Telemóvel**: 910655375

Número do Bilhete de Identidade: 13218934

Título da Dissertação:

Firearm Suicides in the North of Portugal

Orientador:

Professor Doutor Agostinho José Carvalho dos Santos

Ano de conclusão: 2011

Designação da área do projecto:

Medicina Legal

Faculdade de Medicina da Universidade do Porto, 19/04/2011

Assinatura: Ana Luísa Faceira Valente

U.PORTO
FMUP FACULDADE DE MEDICINA UNIVERSIDADE DO PORTO
UNIDADE CURRICULAR PROJECTO DE OPÇÃO
DISSERTAÇÃO/MONOGRAFIA/RELATÓRIO DE ESTÁGIO

Projecto de Opção do 6º ano - DECLARAÇÃO DE INTEGRIDADE

Unidade Curricular "Dissertação / Monografia / Relatório de Estágio Profissionalizante"

Eu, Ana Luísa Faceira Valente, abaixo assinado, nº mecanográfico 050801129, estudante do 6º ano do Mestrado Integrado em Medicina, na Faculdade de Medicina da Universidade do Porto, declaro ter actuado com absoluta integridade na elaboração deste projecto de opção.

Neste sentido, confirmo que **NÃO** incorri em plágio (acto pelo qual um indivíduo, mesmo por omissão, assume a autoria de um determinado trabalho intelectual, ou partes dele). Mais declaro que todas as frases que retirei de trabalhos anteriores pertencentes a outros autores, foram referenciadas, ou redigidas com novas palavras, tendo colocado, neste caso, a citação da fonte bibliográfica.

Faculdade de Medicina da Universidade do Porto, 19/04/2011

Assinatura: Ana Luísa Faceira Valente

Firearm Suicides in the North of Portugal

Ana Faceira [a], Agostinho Santos [a,b], Lino Aranda Assunção [a,b]

[a] Faculty of Medicine of Oporto University

[b] National Institute of Legal Medicine – North Branch

Authors´contact:

Ana Luísa Faceira Valente
Faculty of Medicine of Oporto University
Alameda Prof. Hernâni Monteiro 4200 - 319 Porto, Portugal
(+351) 910655375/med05129@med.up.pt

Agostinho José Carvalho dos Santos
National Institute of Legal Medicine – North Branch
Jardim Carrilho Videira 4050-167 Porto, Portugal

Lino Alberto Aranda Assunção
National Institute of Legal Medicine – North Branch
Jardim Carrilho Videira 4050-167 Porto, Portugal

Abstract

Suicide by firearms is an understudied phenomenon in Portugal. The aim of our study was to analyze the proportion of suicide by firearms in all suicide cases occurred in the North of Portugal, evaluate their characteristics, identify the risk factors and precipitating circumstances, and suggest possible prevention measures.

We reviewed the autopsy reports in suicides by firearm occurred between 2005 and 2009, being the autopsies performed at the North Branch of the National Institute of Legal Medicine (Portugal) and its Offices (n=170).

From all suicide cases, 12.9% were committed using firearms. A 95.3% of the victims were male. The age range in which suicide by firearms was more frequently observed was between 45 and 54 year-old, being the minimum age of 15 year-old and the maximum age of 90 year-old. A 73.3% of the victims used handguns (pistol caliber 6.35mm) and 88.8% shoot themselves in the head and/or neck. The shooting distance was “contact” or “near contact” in all cases. A 20.6% of the victims screened positive for blood alcohol. Psychiatric disorders previous medical history was absent in 52.5% of the cases and other diseases were ruled out in 52.3% of the cases. Nevertheless, psychiatric and other disorders were considered to act as a precipitating factor of suicide in 17.8% and 21.4%, respectively. Previous history of psychiatric disorders and communication of suicidal intent were significantly related (p=0.002).

The determination of the manner of death and the knowledge of the victims´ characteristics are possible due to the investigation in Forensic Medicine. Strategies to reduce the number of suicides by firearm depend largely

on reducing the access to the weapon, through the application of more restrictive laws and control of illegal markets.

Keywords: firearm; suicide; entrance wounds; prevention

Introduction

Suicide is "a particular social phenomenon necessitating investigation, understanding, and intervention" [1]. It is considered a public health problem and one of the leading causes of death all over the world [2-5]. Furthermore, it is a major cause of preventable deaths worldwide [4]. Almost one million people die every year from suicide, which represents a mortality rate of 16 per 100,000 or one death every 40 seconds [2]. The victim lives in society and suicide also affects the family and friends, in emotional, social and economical terms [3, 4]. Moreover, the loss of potential years of life and economic costs related to suicide are a major burden to society [3].

The suicide rate, the suicidal behavior and, more specifically, the choice of the used method varies from country to country [6, 7]. Suicide by firearms is common in some countries like the United States of America (U.S.A.) and Switzerland and is relatively rare in England [6, 8-12]. In Portugal, between 2002 and 2003, suicide by firearms accounted for 11.1% of suicide deaths in men and 3.2% of suicide deaths in women [6]. The proportion of firearm suicides is higher when firearms are common in private households [9, 10, 12-17].

The availability and socio-cultural acceptability are essential, insofar as the suicide method that is most available and socially acceptable will be the more frequently used [6, 8, 18, 19]. More specifically, compared with other methods of suicide, suicide by firearm is more dependent on the availability of the method [6, 12]. This relationship between the availability of firearms and suicide can be understood taking into account the "situational properties" of firearm suicides [10]. The choice of firearms as a method of suicide appears to be precipitated by stressful or painful life events and it requires little preparation, resulting from impulsive decisions more often than other methods [8, 10, 13]. It is also the most lethal, regardless of age and gender, and thus a suicide attempt with a firearm rarely allows a second opportunity [9, 20].

The suicidal crises are time limited and of short duration [9, 21]. Once the acute crisis is over, the intention to commit suicide decreases [9, 21]. It is expected, and has been shown in some studies, that the introduction of more restrictive laws regarding firearms will lead to a decreased rate of firearm suicide [1, 11, 12, 20, 22-25]. Therefore, effective prevention should have as one of its goals to reduce access to lethal methods, which can make the difference between life and death [9, 11, 12, 20, 23-25].

One of the main objectives of the investigation in Forensic Medicine is to establish the differential diagnosis between suicide, homicide and accident, which may render a crucial aid in the characterization of suicidal behavior and suicide by firearms [26]. Suicidal behavior has numerous underlying causes. Identifying risk factors that predispose to suicide and understand their role in suicidal behavior appears to be central in prevention [3].

Thus, the aim of our study was to analyze the proportion of suicide by firearms, evaluate their characteristics, identify the risk factors and precipitating circumstances, and suggest possible prevention measures.

Materials and methods

We developed a retrospective study on suicides by firearm occurred between January 1st 2005 and December 31st 2009, being autopsies performed at the North Branch of the National Institute of Legal Medicine (Portugal) and its Offices (Braga, Bragança, Chaves, Guimarães, Penafiel, Viana do Castelo, Vila Real, Santa Maria da Feira, Mirandela) (n=178). No previous clinical history or police records were available for consult.

A structured data extraction form was created to record information about each case. This included the social and sociodemographic characteristics of the victims, past medical history, previous suicide attempts, information regarding the circumstances in which the suicide occurred and, in addition, information about the type of gun, the owner of the gun, licensing details, shooting distance, number and location of entrance wounds and time between shooting and death.

The information collected was introduced into a database using the program "Statistical Package for Social Sciences v18.0 (SPSS Inc.2010)", which was also used to perform the statistical analysis.

Results

There were 178 suicides by firearm in the North of Portugal, between January 2005 and December 2009 (12.9% of all suicide cases; n=1375). Figure 1 shows that the proportion of suicides by firearm in all cases of suicide varies over the five year period analyzed, and it is not possible to note a trend of increasing or decreasing in the use of firearms. One hundred and seventy cases were analyzed.

- Sociodemographic characteristics

One hundred and sixty two victims (95.3%) were male and only 8 (4.7%) were female.

Table 1 shows the distribution of suicide by gender and age group. There were no victims under 15 years of age. As shown in Table 1, the proportion of suicides by firearm increased progressively from the [15-24yo] age group up to the [45-54yo] age group, and gradually decreasing so on until the last age group. There were no victims over 90 years. There was no relationship between age group and gender of the victim ($p = 0.285$).

In 168 cases the marital status of the victim was known: 104 were married (61.9%), 36 were single (21.4%), 16 (9.5%) were divorced and 12 (7.1%) were widowed. The victims´ residence was known in 165 cases with 86 of them (52.1%) living in a rural area and 79 (47.9%) in an urban area.

In 165 cases the victims´ employment was known. 87 of the victims (60.0%) were employed, 51 (35.2%) were retired and 7 (4.8%) were unemployed. The current or previous occupation was known in 112 cases. The most frequent occupation was shopkeeper (n=24, 21.4%) and farmer (n=12, 10.7%) and only 12 victims (10.7%) were or had been in occupations which enabled access to firearms (security forces, law enforcement agencies).

- Psychiatric and medical history

Information regarding the history of psychiatric disease had been noted in 118 cases. 62 victims (52.5%) had no psychiatric disease and 56 (47.5%) did have. In 40 victims the disease had been specified: Depression was the most frequent disease (n=38, 95.0%), while Schizophrenia was present in one case and Mental Retardation was present in another case.

Information regarding the history of other diseases had been noted in 132 cases. In little more than half of the victims (n=69, 52.3%) there was no relevant past medical history. In the remaining 63 victims, 14 (10.6%) had heart disease, 13 (9.8%) neurologic disease, 10 (7.6%) oncologic disease, 9 (6.8%) pulmonary disease, 11 (8.3%) isolated disease of other systems and 6 (4.5%) a combination of diseases of various systems.

- Habits

Information regarding the consumption of alcohol had been noted in 145 cases: 83 (57.2%) were current consumers at the time of death, 7 (4.8%) had a history of previous consumption and 55 (37.9%) had no history of alcohol consumption. In 74 cases out of the 90 cases where the consumption of alcohol was quantified, 18 (24.3%) were chronic alcoholics.

In 143 cases the smoking habits were known: 75 (52.4%) had no history of smoking while 63 (44.1%) victims were smokers and 5 (3.5%) were ex-smokers.

Possible previous history of illegal drug abuse had been investigated in 119 cases of which 110 (92.4%) had no history of consumption.

- Family history

In only 13 cases the possibility of suicide in close relatives of the victim was explored: in 8 cases there was no history unlike what happened in the remaining 5 cases. Firearms were used as a method of suicide in 2 of the cases.

Regarding the information about the existence of suicide attempts in close relatives and the history of psychiatric disease, information was obtained in only 9 cases. Two cases had a psychiatric disorder history in the family and in none of them a history of suicide attempt was known.

- Date

The month in which suicide was committed was known in 161 cases. No differences were found between months, being June the month in which there were more suicides by firearm (n=18, 11.2%) and November the month in which less suicides by firearm occurred (n=8, 5.0%).

- Location of act

Approximately 3/4 of the 162 suicides in which the location was known occurred in victims' home (n=122, 75.3%). The division of the house where the suicide occurred was known in 81 cases and the most common locations were: bedroom (n=40, 49.4%), sitting room (n=10, 12.3%), garage (n=9, 11.1%), bathroom (n=6, 7.4%) and kitchen (n=5, 6.2%). The remaining cases occurred in a public place (n=17, 10.5%), in the car (n=15, 9.3%), and in the workplace (n=8, 4.9%).

- Suicidal intent/circumstances

In 91 cases the information about verbal communication of suicidal intent was available: 55 victims (60.4%) communicated their suicidal intent. The person to whom the victims expressed their intent was known in 24 cases: the spouse (n=10, 41.7%) and friends (n=4, 16.7%) were those to whom the communication was made more frequently. The moment in which the communication was done was known only in 14 cases: 6 victims (42.9%) made the communication less than 1 day before and 3 made it less than 1 week before (21.4%). Using

Fisher's Test, was found that a previous history of psychiatric disease and the communication of suicidal intent were significantly related ($p = 0.002$).

In 60 cases, the information about the presence or absence of someone else in the moment of the suicide was known: 21 (35.0%) victims were alone, 8 (13.3%) committed the suicide with someone present and 31 (51.7%) had someone nearby but out of visual contact.

Regarding the 53 cases where the existence of a suicide note was investigated, 28 victims (52.8%) did not write a suicide note, 22 (41.5%) wrote a suicide note which was not available to us and 3 (5.7%) wrote a suicide note which was made available to us.

- Motives

Table 2 shows the information collected in the social reports in order to determine the nature of the life events faced by the victim in the period preceding death. The information available was not always relevant and in many cases it was non-existent.

As seen in Table 2, 88 victims (78.6%) exhibited precipitating factors to the suicidal act. Psychiatric diseases were considered the precipitating factor in 17.8% (n=20) of the victims (35.7% of victims with known psychiatric disease), and the existence of other diseases in 21.4% (n=24) of victims (38.1% of victims with a history of other diseases).

- Previous suicide attempts

In the 65 cases in which information about previous suicide attempts was available, 48 (73.8%) had no previous attempts and the remaining 17 (26.2%) had previous attempts. Most victims tried to commit suicide at least once before (12 of the 14 cases in which information was known) poisoning being the most common method chosen (12 of the 16 cases in which information was known).

- Discovery of the victim

The identification of the person who found the victim after committing suicide was available in 110 cases. In 69.1% (n=76) of cases the victim was found by a family member, most often by the spouse (n=45, 40.9%).

More than half of the victims (n=109, 64.1%) were found dead, while 35.9% (n=61) of the victims were found alive and undergone medical intervention. The time elapsed between the discovery and death was known in 50 victims, in which more than half (n=29, 58.0%) died more than 24 hours after the discovery.

- Firearms

In 131 cases the firearm used to commit suicide was known: 96 victims used a handgun (73.3%) and 35 used a shotgun (26.7%). In 45 cases there was information available regarding the ownership of the firearms, which in 31 cases belonged to the victim (68.9%). Information about the firearm license was rarely available: 22 of the firearms used were licensed and 2 were not licensed.

- Location of entrance wounds

A detailed list of the location of entrance wounds in relation to the firearm used, whether the type is known or not, is shown in Table 3.

In the 170 cases of suicide by firearm were found 172 entrance wounds, because in two cases (1.2%) there were two entrance wounds.

The most common anatomical regions were the head and/or neck (n=151, 88.8%). This location was found in 75% (6/8) of females and 89.5% (145/162) of males. In turn, the entrance wounds in the chest represented 8.8% (n=15) of the cases and those in the abdomen represented 2.4% (n=4) of the cases.

Using the Chi-Square Test, it was possible to observe that the location of entrance wounds was associated with the type of firearm used (p = 0.001). When a handgun was used, the head and/or neck were the most common locations.

- Shooting distance

The shooting was carried out with the firearm at a "near contact" distance in 39 (55.7%) of the 70 cases in which information about the shooting distance was available. The remaining 31 shots (44.3%) were carried out with the firearm at "contact" distance.

- Toxicology

From the 169 cases in which information was available, toxicological study was performed in 126 (74.6%). The results were already available in 107 cases, and in 70 cases (65.4%) screened negative for alcohol, illegal abuse drugs and standard searched pharmaceutical drugs.

Blood alcohol was detected in 22 cases (20.6%). In 18 of them it was possible to quantify the blood alcohol concentration: 6 cases (33.3%) had an alcohol concentration lower than 0.5 g/L, 2 cases (11.1%) had an alcohol concentration higher or equal to 0.5 g/L and lower than 0.8 g/L, and 10 cases (55.6%) had an alcohol concentration higher or equal to 1.2 g/L.

Standard searched pharmaceutical drugs were detected in the blood in 17 cases. All cases had a history of medical intervention immediately before death and concentrations of drugs in therapeutic ranges.

In 2 cases the presence of illegal drugs was detected and in 1 of these cases the victim had a known history of using these substances.

- Firearm discharge residues (GSR)

GSR collection is more often performed by the police investigators at the death scene. In case it is not done, the presence of GSR is investigated at the medico-legal services (in this study n=24), being the results already available in 10 cases. In 7 of the 10 cases the result was positive for the right hand, in 2 of the 10 cases the result was positive for the left hand and in the remaining cases the result was negative.

Of the 21 cases in which a study was performed to detect the presence of GSR at the entrance wound, the result was known in 6 cases: 4 cases were positive and 2 cases were negative.

Discussion

In the period between January 2005 and December 2009, 1375 suicides were registered at the North of Portugal (7.8 / 100000 inhabitants, in 2009), 178 (12.9%) of which were committed with a firearm (1.0 / 100000 inhabitants, in 2009). Data from previous studies showed that in 2000 the proportion of suicides by firearm in Portugal was 7.6% [12], and that between 2002 and 2003 this method accounted for a proportion of 11.1% of the total suicides in men and 3.2% in women [6]. Nevertheless, data that focus on the importance that this method of suicide reached in Portugal are scarce, making it difficult to define what is the role that firearms have among the

methods of suicide and what was the evolution of this role over the years. Comparing the proportion of firearm suicides obtained in our study with previous data from other countries, it was possible to show that is lower than that reported for countries like the U.S.A. [6, 8, 9, 12], Switzerland [6, 10, 12] and Austria [6, 12, 23], and higher than those, like England [6, 11, 12], Ireland [27] and New Zealand [6, 12, 22].

As observed in previous studies [1, 5, 8-11, 13, 14, 17, 23, 27-32], our study showed that most individuals who committed suicide using a firearm were male (95.3%). According to the information from other studies, males' preference on using more violent methods of suicide, as is the case of firearms, may be understood as a result of the existence of certain cultural patterns that associate masculinity with a most violent death, which leads to a greater socio-cultural acceptability of the method in question [1], greater familiarity with the method [33], greater suicidal intent [33], and less concern with the change of body image that suicide can cause (unlike what happens in women who reject violent methods that can cause disfigurement) [14, 29, 33].

In males, suicides by firearm were more frequent in the [45-54yo] age group, whereas in females was more frequent in the [35-44yo] age group. However, no relationship was found between age group and gender of the victim ($p = 0.285$). The lower proportion of total suicides by firearm was represented by the [15-24yo] age group. According to Blum e Nelson-Mmari [34], suicide among individuals between 15 and 29 years represents, in Europe, the second leading cause of death and only death due to unintentional injuries occur more frequently. Data from Portugal indicates that between 2000 and 2004 the suicide rate in the [15-24yo] age group had an increasing trend, mainly observed in males, being the firearm the second most used method in males and the fourth most used in females [35]. Nevertheless, in our study the [15-24yo] age group represented the lower proportion of total firearm suicides and it was not possible to demonstrate the role played by suicide, specifically for suicides by firearm, among causes of death of individuals belonging to this age group.

The data collected in our study regarding the victims´ residence indicated a proportion of victims who lived in rural areas similar to the proportion of victims who lived in urban areas. Higher proportions of victims who lived in rural areas compared with those who lived in urban areas were found in previous studies [1, 11, 27, 32, 36]. This was explained as a consequence of the increased ownership of firearms by individuals who live in rural places [1, 15], i.e., results in greater availability, which is a factor that interferes in the choice of method [6, 12, 19], and greater acceptance of the use of firearms [1]. The uniform distribution of victims by area of residence obtained in our study may be explained by the trend of the population of rural areas which has been observed in recent years, resulting in a smaller number of people and potential victims in these areas.

Approximately eleven percent (10.7%) of victims had farming as their occupation. In previous studies it was demonstrated that this occupation entails a greater risk of suicide [37], specifically suicide by firearms [38]. The small number of victims who were or had been farmers can also be interpreted as a consequence of fewer people in rural areas where this occupation takes place more frequently. In 10.7% of the victims we found an occupation that allows a direct and easy access to firearms. It is reported that individuals who have jobs that allow access to firearms do not have a suicide rate higher than the general population, but when suicide occurs firearms are the most commonly used method [39]. Apart from easy accessibility to the method, the diffusion of suicide by firearms in law enforcement officers can contribute to the greater popularity of the method. The media coverage can also contribute to the idea that these individuals are at increased risk of suicide, which was not observed [39].

In our study we revealed the existence of psychiatric disease in less than half of the victims (47.5%), being depression responsible for most cases. According to Cavanagh et al [40], psychiatric disease is present in 90% of individuals who commit suicide, being the mood disorders the disease most often found. However, regarding suicide by firearms, the data are not unanimous. According to Price et al [16], suicide by firearms is positively associated with the prevalence of serious mental illness. However, other previous studies have reported that victims of firearm suicides do not appear to have a long history of psychiatric disease [1, 8]. This fact can be explained by the less likely occurrence of suicide by firearms as a result of care in mental health or use of antidepressants [41], the less access to firearms by people who have this type of disease [8] and the spontaneous nature of suicide by firearm [1].

In our study the psychiatric disease had a causal role in 17.8% of suicide victims (representing 35.7% of victims with a known diagnosis of psychiatric disease). These data may allow supposing that, despite the diagnosis of psychiatric disorders, the individuals may not be motivated for their treatment, which may result in stopping or discontinuation of therapy. Another issue that may lead to concern is the restriction of access to firearms in these individuals. It is described that would be important that health professionals were alerted to the situation of possession of firearms in patients with psychiatric disorders [7, 11, 42], and if the situation justified (for example, in patients with suicidal ideation and marked self-destructive intent), the firearm and its license could be withdrawn, using the necessary resources for this, until the clinical condition was stabilized [7, 11]. Considering that depression is the disease most often found, it is important to question these individuals about the existence of suicidal ideation or intent [7].

The firearm is chosen as a method of suicide as a result of impulsive decisions, compared to other methods [4, 7, 10, 13]. However, most people who act impulsively at the time of suicide had suicidal ideation before the suicide attempt [42]. According to this, in our study verbal communication of suicidal intent was made for 60.4% of the victims. Furthermore, the history of psychiatric disease and the presence of communication of suicidal intent were significantly related ($p = 0.002$). Thus, these individuals often express their suicidal thoughts directly, without this being taken as a genuine intentionality. Intervention and monitoring may be important.

The history of other diseases (other than psychiatric disease) was identified as the precipitating factor in 21.4% of victims (which represents 38.1% of victims who had other diseases). This may be relevant and indicates the need for physicians to be aware of how the patient experiences his illness, even if their life is not at risk, because fear of depending on others or fear of losing their independence may also be important factors.

Although we have revealed that 57.2% of the victims were regular consumers of alcohol and more than half (59.5%) of those in which consumption was measured showed a slight consumption, 24.3% had chronic alcoholism. Individuals with alcohol dependence have a higher risk of suicide than people without this dependence [43, 44]. However, Kaplan et al [8] argued that a history of alcoholism was rarely present in victims of suicide by firearms. In our study a relatively low proportion of individuals with chronic alcohol consumption was revealed, although it becomes important to be aware of the possession of firearms by those individuals, being necessary to raise awareness among families, once these victims may refuse treatment and not always seek medical care.

In our study we revealed that 20.6% of the victims where a toxicological study was performed had alcohol in the blood. Alcohol concentration was measured in 18 cases and, in 55.6% of them, the blood alcohol concentrations were greater than or equal to 1.2g/L. The des-inhibition due to alcohol intoxication [11, 43]

probably predisposes to an increase in suicidal ideation and in suicidal intent, increasing the risk that suicidal thoughts can be put into practice, often impulsively [43]. In addition, when under the influence of alcohol, individuals are more likely to attempt suicide using methods that involve a low probability of survival [43].

Furthermore, Kaplan et al [8] conceded that the male victims were more likely to be intoxicated at the time of suicide (but without necessarily having a history of alcoholism). In our study the data regarding the blood alcohol analysis also indicated a relatively low proportion of alcohol intoxication at suicide, which can be explained by the fact that this study was not performed routinely, either by choice of the doctor who was conducting the autopsy or by excessive time between the autopsy and the act of suicide, which means that this proportion does not reflect the real value of alcoholic intoxication in victims of suicide by firearms. Karger et al [31] revealed that the homicide victims had blood alcohol less frequently than the suicide victims, which means that the blood alcohol analysis may be useful in establishing the medico-legal diagnosis.

We revealed that the analysis for illegal abuse drugs and medical drugs were performed less frequently than the alcohol analysis. According to Shields et al [45], the results of the toxicological study may provide support or refuse the hypothesis of an association of chemicals in cases in which the main method is not the use of these substances.

Information on the history of suicide attempts or completed suicide in the close relatives of the victim and a history of psychiatric illness in the family was nearly nonexistent. A significant increase in suicide risk was observed in individuals with a family history of suicide and psychiatric illness [46], which can make the collection of this information a relevant fact.

The information concerning the circumstances under which the suicide occurred was scarce. However, in 65.0% of the cases, the suicide was committed with someone present with or without visual contact with the victim. This can be explained by the impulsivity of the act [47].

Information on previous suicide attempts had been poorly investigated and had been demonstrated that 73.8% of victims had no previous attempts. As a consequence of the spontaneous nature of the suicidal act on the victims of suicide by firearms, is less likely that they have a history of previous attempts [1, 30, 48], which is consistent with the data that were obtained in our study. The use of more impulsive methods and an uncommon history of previous suicide attempts is characteristic of those who didn´t plan the suicide [48]. Also characteristic of these individuals is the existence of factors that may precipitate the suicide, which was found in 78.6% of victims in our study. In the remaining 21.4% of victims precipitating factors to the suicidal act were not found which does not mean that victims have not faced such problems. This could be due to the fact that the people who provide social information about the victim, which are not always their close relatives, simply do not have knowledge of this fact and assume their absence.

In our study, most suicides were accomplished by shots fired in the head and/or neck, which was consistent with several previous studies [11, 28, 30, 31]. In addition, it was demonstrated a relationship between the location of entrance wounds and the type of firearm used ($p=0.001$). When a handgun was used, and comparing with the shotgun, the head and/or neck were achieved more often, which was consistent with previous studies [28, 30].

When the firearm was used by females, and according to the hypothesis of rejection of more violent methods, studies revealed that they shoot themselves, more often than males, in locations that did not include the head and neck [14, 30], being demonstrated that the location of the entrance wound was associated with gender

[30]. The data obtained in our study did not support this association which may be a consequence of the small number of females who committed suicide by firearms in order to obtain significant results. In our study, 75% of females and 89.5% of males shoot themselves in the head and neck. This difference may be explained, as already mentioned, for fear of disfigurement subsequent to the shot in the head and neck [14, 29, 33].

Kohlmeier et al [30] revealed that the handgun was the most common firearm chosen to commit suicide by females. However, in our study no relationship was found between gender and firearms, possibly due to the small number of female victims and due to the lack of information regarding the firearm in some cases.

Previous studies revealed that, in the case of suicide, shooting was mostly carried out in contact or near contact [28, 30, 31, 49]. In our study, all shots were performed with the firearm at “contact” or “near contact” distance. The absence of a device to pull the trigger of the shotguns, which is necessary to achieve longer shooting distances that are not within arm's reach, can explain the fact that the shooting distance is maintained in contact or in near contact when a shotgun is used [49].

The estimate of shooting distance is obtained by the investigation of firearm discharge residues (GSR) and this is important in establishing the medico-legal diagnosis [26, 50]. In the contact shootings these discharge residues penetrate in the entrance wound with the projectile, while in the near contact shootings the discharge residues are deposited around the entrance wound or directly into the cloth that is covering the area of impact, and its concentration per surface area is different depending on the shooting distance [50]. However, in our study this investigation was rarely performed. In 2 of the 6 cases in which the results were known, these were negative. This fact can be explained by a prior washing or by an inadequate method of collecting the residues.

The choice of method of suicide is determined by two variables: the sociocultural acceptability and availability [19]. Regarding to firearm suicide, this seems to be more determined by the availability compared to other methods of suicide [6, 12]. The possession of a firearm carries a higher risk of suicide by firearms [9, 10, 13, 14, 16, 17], and is considered the only significant predictor of the proportion of suicides committed by this method [10]. Therefore, restricting access to the methods of suicide, particularly the most lethal, as is the case of firearms, is a key element in preventive strategies [11, 12, 20, 23-25]. This restriction may interfere with the transition from ideation to suicide attempt [12, 25], and, taking into account the lethality of different methods, can also affect the probability that this results in death, with the consequent reduction in mortality from suicide [20, 25]. Even if, as a consequence of reducing access to firearms, the substitution of the method occurs, the proportion of people surviving after the suicide attempt will increase because the firearm is one of the methods of suicide that is considered more lethal [25]. The possibility of method substitution occur when access to firearms is restricted may be a proof that prevention has to involve not only a measure but a set of measures that can contribute to a significant decrease in the rate of suicide, which is compatible with the complexity of suicide [7, 12].

Some limitations may be indicated. It was not possible to have access to police reports, which limited the available information about the death scene as well as the information related to firearms, especially regarding the existence of a firearm license. Furthermore, clinical reports were not available to be consulted which limited the information about the past medical history of victims and could not confirm or refuse the information from the social inquiry. The quality of information, predominantly information obtained from social inquiry, has not disclosed some information considered important in the context of suicide due to lack of response to questions from the inquiry used. Furthermore, this lack of information can be explained by the change in the social inquiry

that occurred during the time period analyzed. To ensure that information obtained is uniform in all Offices, both in quality and quantity, can be considered useful that the inquiry used for the collection of social information consists of multiple choice questions, with a structure for easy reading and comprehension.

Forensic Medicine occupies a unique and privileged position to obtain information about the suicide victims, especially when the method is as lethal as a firearm, in which the possibility of doing the study in survivors of suicide attempts with this method is relatively low.

Conclusion

Forensic Medicine should go further than determining the medico-legal diagnosis. Preventive strategies depend largely on the knowledge of these characteristics, so that we can act more effectively in the common point or in the most often point found in suicides. In that case, prevention will be effective for a greater number of individuals.

The information obtained in the examination of the death scene, the knowledge of the circumstances preceding the death, the victims´ characteristics, the gun/ammunition used, number of shots, the shooting distance and the location of the entrance wound are essential to establish the diagnosis.

There were 178 suicides by firearm in the North of Portugal, between January 2005 and December 2009 (12.9% of all suicide cases; n=1375).

The use of a firearm as a suicide method in Northern Portugal is relatively common, especially taking into account the current Portuguese legislation that is very restrictive. Previous data on the proportion of suicides using this method in our population are scarce and time periods studied are relatively short, so more studies are needed in order to determine the popularity of firearms as a method of suicide in Portugal.

The male gender, the communication of suicidal intent, the existence of precipitating factors of suicide and not known previous attempts were some of the most commonly characteristics encountered. In addition, shooting carried out in the head and/or neck, in “contact” or “near contact” distance, was also found in most cases. Although psychiatric disease was not a feature as often present as those mentioned above, depression was a disorder that was commonly found when a history of psychiatric disease was known. The communication of suicidal intent was associated in our study with a history of depressive disorder, so these individuals may be faced as a target of preventive measures.

Despite the precipitating factors that do seem to exist in most cases, no factor distinguished itself with a frequency significantly higher than the rest.

Restricting access to firearms is presented as being the focus of prevention of suicide by this method. The authors consider it is important that information such as the existence of a firearm license and how the firearm is kept in house must be collected. Knowing this information can induce a change to a more restrictive law in cases where firearms used are legal, or may increase the combat to illegal markets in cases where firearms used are illegal.

Integrity of research and reporting

Ethical standards

The authors developed a retrospective study and were not carried out any intervention.

Conflict of interest

The authors declare that they have no conflict of interest.

References

[1] Tait G, Carpenter B (2009) Firearm suicide in Queensland. J. Sociol. 46: 83-98

[2] http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/, accessed on September 1st 2010

[3] Krug EG, et al. World report on violence and health. Geneva: World Health Organization 2002

[4] World Health Organization. (2009). A Resource for police, firefighters and other first line responders. Geneva: Author

[5] Romero MP, Wintemute GJ (2002) The Epidemiology of Firearm Suicide in the United States. J Urban Health: Bull. N. Y. Acad. Med. 79:39-48

[6] Ajdacic-Gross V, Weiss MC, Ring M, Hepp U, Bopp M, Gutzwiller F, Rössler W (2008) Methods of suicide: international suicide patterns derived from the WHO mortality database. Bull. World Health Organ. 86:726-732

[7] Hawton K, Heeringen K (2009) Suicide. Lancet 373:1372-1381

[8] Kaplan MS, McFarland BH, Huguet N (2009) Characteristics of adult male and female firearm suicide decedents: findings from the National Violent Death Reporting System. Inj. Prev. 15:322-327

[9] Miller M, Hemenway D (2008) Guns and suicide in the United States. The N. Engl. J. Med. 359:989-991

[10] Ajdacic-Gross V, Killias M, Hepp U, Haymoz S, Bopp M (2010) Firearm suicides and availability of firearms: The Swiss experience. Eur. Psychiatry 25:432-434

[11] Sutton L, Hawton K, Simkin S, Turnbull P, Kapur N, Bennewith O, Gunnell D (2005) Gunshot suicides in England. A multicentre study based on coroners' records. Soc. Psychiatry Psychiatr. Epidemiology 40:324-328

[12] Ajdacic-Gross V, Killias M, Hepp U, Gadola E, Bopp M, Lauber C, Schnyder U, Gutzwiller F, Rössler W (2006) Changing Times: A Longitudinal Analysis of International Firearm Suicide Data. Am. J. Public Health 96:1752-1755

[13] Dahlberg LL, Ikeda RM, Kresnow M (2004) Guns in the Home and Risk of a Violent Death in the Home: Findings from a National Study. Am. J. Epidemiology 160:929-936

[14] Kposowa AJ, McElvain J (2006) Gender, place, and method of suicide. Soc. Psychiatry Psychiatr. Epidemiology 41:435-443

[15] Wiktor SZ, Gallaher MM, Baron RC, Watson ME, Sewell CM (1994) Firearms in New Mexico. The Western J. Med. 161:137-139

[16] Price JH, Mrdjenovich AJ, Dake JA (2009) Prevalence of State Firearm Mortality and Mental Health Care Resources. J. Community Health 34:383-391

[17] Shenassa ED, Rogers ML, Spalding KL, Roberts MB (2004) Safer storage of firearms at home and risk of suicide: a study of protective factors in a nationally representative sample. J. Epidemiology Community Health 58:841-848

[18] Stack S, Wasserman I (2005) Race and method of suicide: culture and opportunity. Arch. Suicide Res. 9:57-68

[19] Cantor CH, Baume PJM (1998) Access to methods of suicide: what impact?. Aust. N. Z. J. Psychiatry 32:8-14

[20] Shenassa ED, Catlin SN, Buka SL (2003) Lethality of firearms relative to other suicide methods: a population based study. J. Epidemiology Community Health 57: 120-124

[21] Daigle MS (2005) Suicide prevention through means restriction: Assessing the risk of substitution. A critical review and synthesis. Accident Anal. Prev. 37:625-632

[22] Beautrais AL, Fergusson DM, Horwood LJ (2006) Firearms legislation and reductions in firearm-related suicide deaths in New Zealand. Aust. N. Z. J. Psychiatry 40:253-259

[23] Kapusta ND, Etzersdorfer E, Krall C, Sonneck G (2007) Firearm legislation reform in the European Union: impact on firearm availability, firearm suicide and homicide rates in Austria. Br. J. Psychiatry 191:253-257

[24] Mann J, Apter A, Bertolote J, Beautrais A, Currier D, Haas A, Hegerl U et al (2005) Suicide Prevention Strategies: A Systematic Review. J. Am. Medical Assoc. 294:2064-2074

[25] Florentine JB, Crane C (2010) Suicide prevention by limiting access to methods: A review of theory and practice. Soc. Sci. Med. 70:1626–1632

[26] Carvalho I, Santos A (2010) Fundamentos para o diagnóstico médico-legal entre suicídio, homicídio e acidente por armas de fogo. Dissertation, Faculty of Medicine of Oporto University

[27] Sarma K, Kola S (2010) Firearm suicide decedents in the Republic of Ireland, 1980-2005. Public Health 124:278-283

[28] Balci Y, Canogullari G, Ulupinar E (2007) Characterization of the gunshot suicides. J. Forensic Legal Med. 14:203-208

[29] Schmeling A, Strauch H, Rothschild MA (2001) Female suicides in Berlin with the use of firearms. Forensic Sci. Int. 124:178-181

[30] Kohlmeier RE, McMahan CA, DiMaio VJM (2001) Suicide by Firearms. A 15-year Experience. The Am. J. Forensic Med. Pathol. 22:337-340

[31] Karger B, Billeb E, Koops E, Brinkmann B (2002) Autopsy features relevant for discrimination between suicidal and homicidal gunshot injuries. Int. J. Legal Med. 116:273-278

[32] Klieve H, Sveticic J, De Leo D (2009) Who use firearms as a means of suicide? A population study exploring firearm accessibility and method choice. BMC Med. 7:52

[33] Hawton K (2000) Sex and suicide. Gender differences in suicidal behaviour. The Br. J. Psychiatry 177:484-485

[34] Blum RW, Nelson-Mmari K (2004) The health of young people in a global context. J. Adolesc. Health 35:402-418

[35] Värnik A, Kõlves K, Allik J, Arensman E, Aromaa E, Audenhove C, Bouleau JH et al (2009) Gender issues in suicide rates, trends and methods among youths aged 15-24 in 15 European countries. J. Affect. Disord. 113:216-226

[36] Singh GK, Siahpush M (2002) Increasing rural-urban gradients in US suicide mortality, 1970-1997. Am. J. Public Health 92:1161:1167

[37] Gallagher AG, Sheehy NP (1994) Suicide in Rural Communities. J. Community Appl. Soc. Psychol. 4:145-155

[38] Booth N, Briscoe M, Powell R (2000) Suicide in the farming community: methods used and contact with health services. Occup. Environ. Med. 57:642-644

[39] Marzuk PT, Nock MK, Leon AC, Portera L, Tardiff K (2002) Suicide Among New York City Police Officers, 1977-1996. The Am. J. Psychiatry 159:2069-2071

[40] Cavanagh JTO, Carson AJ, Sharpe M, Lawrie SM (2003) Psychological autopsy studies of suicide: a systematic review. Psychol. Med. 33:395–405

[41] Joe S, Marcus SC, Kaplan MS (2007) Racial Differences in the Characteristics of Firearm Suicide Decedents in the United States. Am. J. Orthopsychiatr. 77:124-130

[42] Traylor A, Price J, Telljohann SK, King K, Thompson A (2010) Clinical Psychologists' Firearm Risk Management Perceptions and Practices. J. Community Health 35:60-67

[43] Sher L (2006) Alcohol consumption and suicide. Q J Med 99:57-61

[44] Webster DW, Vernick JS (2009) Keeping firearms from drug abuse and alcohol abusers. Inj. Prev. 15:425-427

[45] Shields LBE, Hunsaker DM, Hunsaker JC, Ward MK (2006) Toxicologic Findings in Suicide A 10-Year Retrospective Review of Kentucky Medical Examiner Cases. Am J Forensic Med Pathol 27: 106–112

[46] Qin P, Agerbo E, Mortensen PB (2003) Suicide Risk in Relation to Socioeconomic, Demographic, Psychiatric, and Familial Factors: A National Register – Based Study of All Suicides in Denmark, 1981–1997. The Am. J. Psychiatry 160:765–772

[47] Wyder M, De Leo D (2007) Behind impulsive suicide attempts: Indications from a community study. J. Affect. Disord. 104:167-173

[48] Jeon HJ, Lee JY, Lee YM, Hong JP, Wone SH, Cho SJ, Kim JY, Chang SM, Lee HW, Cho MJ (2010) Unplanned versus planned suicide attempters, precipitants, methods, and an association with mental disorders in a Korea-based community sample. J. Affect. Disord. 127:274-280

[49] Grandmaison GL, Fermanian C, Aegerter P, Durigon M (2008) Influence of ballistic and autopsy parameters on the manner of death in case of long firearms fatalities. Forensic Sci. Int. 177:207-213

[50] DiMaio VJ (1999) Gunshot Wounds - Practical aspects of firearms, ballistics, and forensic techniques. CRC Press, New York

Tables

Figure 1: Proportion of firearm suicide in all cases of suicide over the years

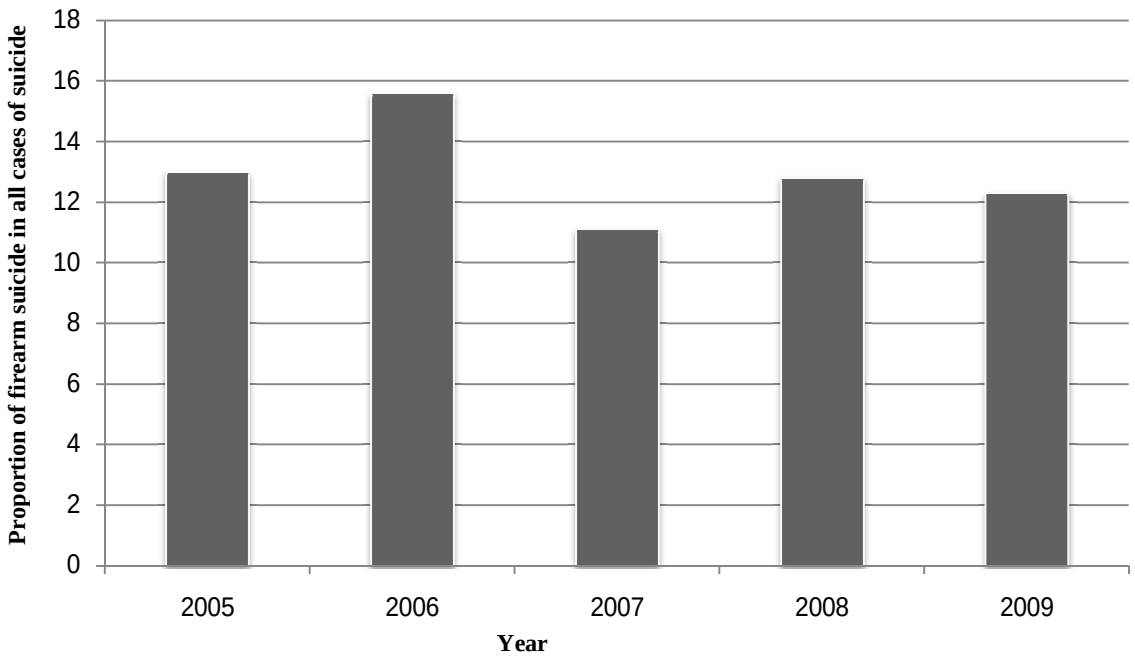


Table 1: Firearm suicides by gender and age group

	Males N (%)	Females N (%)	Both genders N (%)
Age group			
15 – 24	12 (7.4)	2 (25.0)	14 (8.2)
25 – 34	18 (11.1)	1 (12.5)	19 (11.2)
35 – 44	27 (16.7)	3 (37.5)	30 (17.6)
45 – 54	34 (21.0)	1 (12.5)	35 (20.6)
55 – 64	28 (17.3)	-	28 (16.5)
65 – 74	23 (14.2)	1 (12.5)	24 (14.1)
+ 75	20 (12.3)	-	20 (11.8)
All ages	162 (100)	8 (100)	170 (100)

Table 2: Life events in firearm suicide victims

	Number of cases (%)
Life events	
Absent	24 (21.4)
Psychiatric disease	19 (17.0)
Physical health problem	16 (14.3)
Relationship problem	14 (12.5)
Financial problem	9 (8.0)
Recent death of relative or friend	7 (6.2)
Job problem	6 (5.4)
Fear of dependence on others (as a consequence of	5 (4.5)

disease)	
Relationship problem + financial problem	4 (3.6)
Terminal illness	3 (2.7)
Legal problem	2 (1.8)
Alcoholism	1 (0.9)
Health problems in the family	1 (0.9)
Job problem + psychiatric disease	1 (0.9)
Total	112 (100)

Table 3: Location of entrance wound in relation to firearm

Location of entrance wounds	**Handgun**	**Shotgun**	**Unknown**	**Total (%)**
Head and neck	**91**	**27**	**35**	**153 (89.0)**
Right temporal	41	1	20	
Right parietal	12	-	6	
Right frontal	6	-	3	
Right orbit	1	-	-	
Right fronto-temporal	6	-	-	
Right temporo-parietal	2	-	1	
Right facial	1	-	-	
Median frontal	4	4	2	
Left temporal	7	2	-	
Left frontal	1	1	-	
Left facial	-	4	-	
Left temporo-parietal	-	-	1	
Under the chin	1	3	1	
Mouth	9	4	1	
Undetermined	-	8	-	
Chest	**6**	**5**	**4**	**15 (8.7)**
Sternum	-	1	-	
Anterior right	1	-	-	
Anterior left	5	4	4	
Abdomen	**-**	**4**	**-**	**4 (2.3)**
Right	-	1	-	
Left	-	1	-	
Median	-	2	-	
Total	**97**	**36**	**39**	**172 (100)**

Annexes

Annex 1: Instructions for Authors

GUIDELINES FOR PUBLISHING POPULATION DATA

In 1997 Prof. Bernd Brinkmann formulated guidelines for the submission of manuscripts on short tandem repeat (STR) population data (Brinkmann 1997). These earlier guidelines have now been extended to include haploid DNA markers, i.e. mitochondrial DNA (mtDNA) and Y-chromosomal polymorphisms.

For specific information, see the Short Communication "Publication of population data of linearly inherited DNA markers in the International Journal of Legal Medicine" (Parson and Roewer 2010; DOI 10.1007/s00414-010-0492-y) published online in Int J Legal Med in July 2010.

All forensic population genetics papers should always contain information on the description of the population, ethical requirements and quality control. For mtDNA papers, previous acceptance of the dataset in EMPOP is required; for YSTR and YSNP data, previous inclusion of the data in the YSTR/YSNP database is required.

- EMPOP database
- YSTR/YSNP database

MANUSCRIPT SUBMISSION

Manuscript Submission

Submission of a manuscript implies: that the work described has not been published before; that it is not under consideration for publication anywhere else; that its publication has been approved by all co-authors, if any, as well as by the responsible authorities – tacitly or explicitly – at the institute where the work has been carried out. The publisher will not be held legally responsible should there be any claims for compensation.

Permissions

Authors wishing to include figures, tables, or text passages that have already been published elsewhere are required to obtain permission from the copyright owner(s) for both the print and online format and to include evidence that such permission has been granted when submitting their papers. Any material received without such evidence will be assumed to originate from the authors.

Online Submission

Authors should submit their manuscripts online. Electronic submission substantially reduces the editorial processing and reviewing times and shortens overall publication times. Please follow the hyperlink "Submit online" on the right and upload all of your manuscript files following the instructions given on the screen.

TITLE PAGE

Title Page

The title page should include:

- The name(s) of the author(s)

- A concise and informative title
- The affiliation(s) and address(es) of the author(s)
- The e-mail address, telephone and fax numbers of the corresponding author

Abstract

Please provide an abstract of 150 to 250 words. The abstract should not contain any undefined abbreviations or unspecified references.

Keywords

Please provide 4 to 6 keywords which can be used for indexing purposes.

TEXT

Text Formatting

Manuscripts should be submitted in Word.

- Use a normal, plain font (e.g., 10-point Times Roman) for text.
- Use italics for emphasis.
- Use the automatic page numbering function to number the pages.
- Do not use field functions.
- Use tab stops or other commands for indents, not the space bar.
- Use the table function, not spreadsheets, to make tables.
- Use the equation editor or MathType for equations.
  Note: If you use Word 2007, do not create the equations with the default equation editor but use the Microsoft equation editor or MathType instead.
- Save your file in doc format. Do not submit docx files.
  Word template (zip, 154 kB)

Manuscripts with mathematical content can also be submitted in LaTeX.

LaTeX macro package (zip, 182 kB)

Headings

Please use no more than three levels of displayed headings.

Abbreviations

Abbreviations should be defined at first mention and used consistently thereafter.

Footnotes

Footnotes can be used to give additional information, which may include the citation of a reference included in the reference list. They should not consist solely of a reference citation, and they should never include the bibliographic details of a reference. They should also not contain any figures or tables.

Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data). Footnotes to the title or the authors of the article are not given reference symbols.
Always use footnotes instead of endnotes.

Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section before the reference list. The names of funding organizations should be written in full.

REFERENCES

Citation

Reference citations in the text should be identified by numbers in square brackets. Some examples:

1. Negotiation research spans many disciplines [3].
2. This result was later contradicted by Becker and Seligman [5].
3. This effect has been widely studied [1-3, 7].

Reference list

The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. Do not use footnotes or endnotes as a substitute for a reference list.
The entries in the list should be numbered consecutively.

- Journal article
  Gamelin FX, Baquet G, Berthoin S, Thevenet D, Nourry C, Nottin S, Bosquet L (2009) Effect of high intensity intermittent training on heart rate variability in prepubescent children. Eur J Appl Physiol 105:731-738. doi: 10.1007/s00421-008-0955-8
  Ideally, the names of all authors should be provided, but the usage of “et al” in long author lists will also be accepted:
  Smith J, Jones M Jr, Houghton L et al (1999) Future of health insurance. N Engl J Med 965:325–329

- Article by DOI
  Slifka MK, Whitton JL (2000) Clinical implications of dysregulated cytokine production. J Mol Med. doi:10.1007/s001090000086

- Book
  South J, Blass B (2001) The future of modern genomics. Blackwell, London

- Book chapter
  Brown B, Aaron M (2001) The politics of nature. In: Smith J (ed) The rise of modern genomics, 3rd edn. Wiley, New York, pp 230-257

- Online document

  Cartwright J (2007) Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1. Accessed 26 June 2007

- Dissertation

  Trent JW (1975) Experimental acute renal failure. Dissertation, University of California

Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see

www.issn.org/2-22661-LTWA-online.php

For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list.

EndNote style (zip, 2 kB)

TABLES

- All tables are to be numbered using Arabic numerals.
- Tables should always be cited in text in consecutive numerical order.
- For each table, please supply a table caption (title) explaining the components of the table.
- Identify any previously published material by giving the original source in the form of a reference at the end of the table caption.
- Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

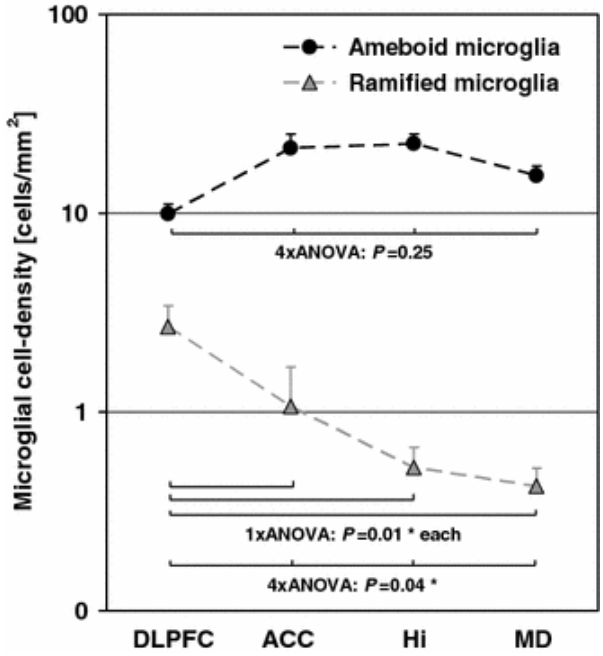
ARTWORK

For the best quality final product, it is highly recommended that you submit all of your artwork – photographs, line drawings, etc. – in an electronic format. Your art will then be produced to the highest standards with the greatest accuracy to detail. The published work will directly reflect the quality of the artwork provided.

Electronic Figure Submission

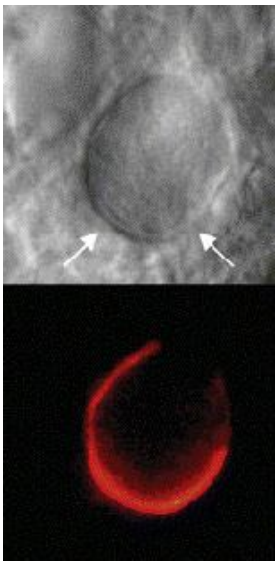
- Supply all figures electronically.
- Indicate what graphics program was used to create the artwork.
- For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MS Office files are also acceptable.
- Vector graphics containing fonts must have the fonts embedded in the files.
- Name your figure files with "Fig" and the figure number, e.g., Fig1.eps.

Line Art



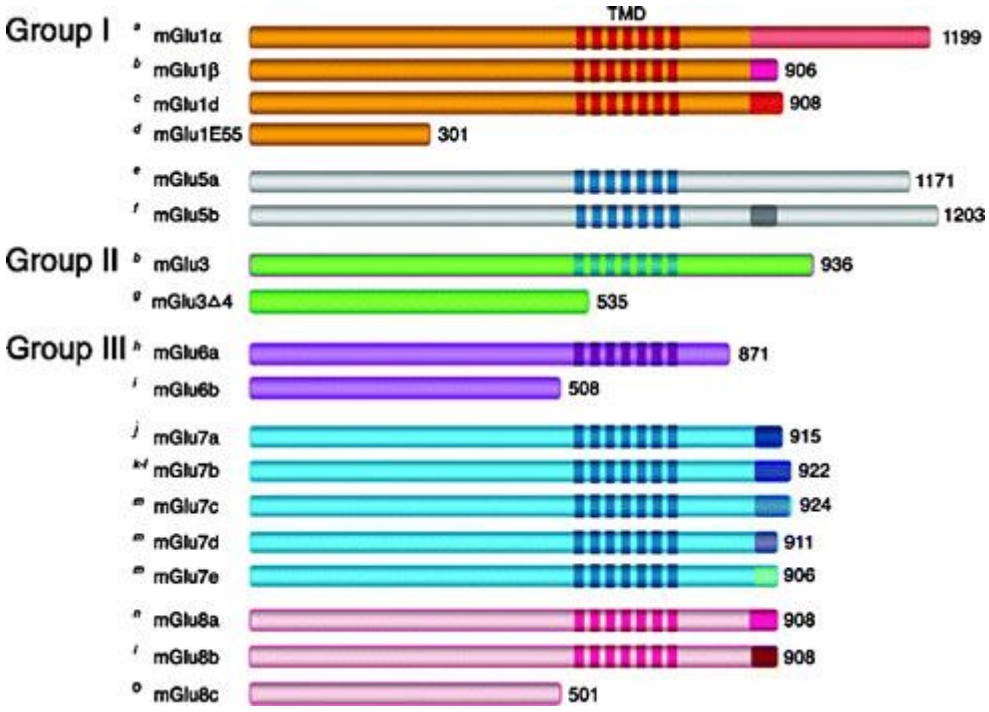
- Definition: Black and white graphic with no shading.
- Do not use faint lines and/or lettering and check that all lines and lettering within the figures are legible at final size.
- All lines should be at least 0.1 mm (0.3 pt) wide.
- Scanned line drawings and line drawings in bitmap format should have a minimum resolution of 1200 dpi.
- Vector graphics containing fonts must have the fonts embedded in the files.

Halftone Art



- Definition: Photographs, drawings, or paintings with fine shading, etc.
- If any magnification is used in the photographs, indicate this by using scale bars within the figures themselves.
- Halftones should have a minimum resolution of 300 dpi.

Combination Art



- Definition: a combination of halftone and line art, e.g., halftones containing line drawing, extensive lettering, color diagrams, etc.
- Combination artwork should have a minimum resolution of 600 dpi.

Color Art

- Color art is free of charge for online publication.
- If black and white will be shown in the print version, make sure that the main information will still be visible. Many colors are not distinguishable from one another when converted to black and white. A simple way to check this is to make a xerographic copy to see if the necessary distinctions between the different colors are still apparent.
- If the figures will be printed in black and white, do not refer to color in the captions.
- Color illustrations should be submitted as RGB (8 bits per channel).

Figure Lettering

- To add lettering, it is best to use Helvetica or Arial (sans serif fonts).
- Keep lettering consistently sized throughout your final-sized artwork, usually about 2–3 mm (8–12 pt).

- Variance of type size within an illustration should be minimal, e.g., do not use 8-pt type on an axis and 20-pt type for the axis label.
- Avoid effects such as shading, outline letters, etc.
- Do not include titles or captions within your illustrations.

Figure Numbering

- All figures are to be numbered using Arabic numerals.
- Figures should always be cited in text in consecutive numerical order.
- Figure parts should be denoted by lowercase letters (a, b, c, etc.).
- If an appendix appears in your article and it contains one or more figures, continue the consecutive numbering of the main text. Do not number the appendix figures, "A1, A2, A3, etc." Figures in online appendices (Electronic Supplementary Material) should, however, be numbered separately.

Figure Captions

- Each figure should have a concise caption describing accurately what the figure depicts. Include the captions in the text file of the manuscript, not in the figure file.
- Figure captions begin with the term Fig. in bold type, followed by the figure number, also in bold type.
- No punctuation is to be included after the number, nor is any punctuation to be placed at the end of the caption.
- Identify all elements found in the figure in the figure caption; and use boxes, circles, etc., as coordinate points in graphs.
- Identify previously published material by giving the original source in the form of a reference citation at the end of the figure caption.

Figure Placement and Size

- When preparing your figures, size figures to fit in the column width.
- For most journals the figures should be 39 mm, 84 mm, 129 mm, or 174 mm wide and not higher than 234 mm.
- For books and book-sized journals, the figures should be 80 mm or 122 mm wide and not higher than 198 mm.

Permissions

If you include figures that have already been published elsewhere, you must obtain permission from the copyright owner(s) for both the print and online format. Please be aware that some publishers do not grant electronic rights for free and that Springer will not be able to refund any costs that may have occurred to receive these permissions. In such cases, material from other sources should be used.

Accessibility

In order to give people of all abilities and disabilities access to the content of your figures, please make sure that

- All figures have descriptive captions (blind users could then use a text-to-speech software or a text-to-Braille hardware)
- Patterns are used instead of or in addition to colors for conveying information (color-blind users would then be able to distinguish the visual elements)
- Any figure lettering has a contrast ratio of at least 4.5:1

ELECTRONIC SUPPLEMENTARY MATERIAL

Springer accepts electronic multimedia files (animations, movies, audio, etc.) and other supplementary files to be published online along with an article or a book chapter. This feature can add dimension to the author's article, as certain information cannot be printed or is more convenient in electronic form.

Submission

- Supply all supplementary material in standard file formats.
- Please include in each file the following information: article title, journal name, author names; affiliation and e-mail address of the corresponding author.
- To accommodate user downloads, please keep in mind that larger-sized files may require very long download times and that some users may experience other problems during downloading.

Audio, Video, and Animations

- Always use MPEG-1 (.mpg) format.

Text and Presentations

- Submit your material in PDF format; .doc or .ppt files are not suitable for long-term viability.
- A collection of figures may also be combined in a PDF file.

Spreadsheets

- Spreadsheets should be converted to PDF if no interaction with the data is intended.
- If the readers should be encouraged to make their own calculations, spreadsheets should be submitted as .xls files (MS Excel).

Specialized Formats

- Specialized format such as .pdb (chemical), .wrl (VRML), .nb (Mathematica notebook), and .tex can also be supplied.

Collecting Multiple Files

- It is possible to collect multiple files in a .zip or .gz file.

Numbering

- If supplying any supplementary material, the text must make specific mention of the material as a citation, similar to that of figures and tables.

- Refer to the supplementary files as “Online Resource”, e.g., "... as shown in the animation (Online Resource 3)", “... additional data are given in Online Resource 4”.
- Name the files consecutively, e.g. “ESM_3.mpg”, “ESM_4.pdf”.

Captions

- For each supplementary material, please supply a concise caption describing the content of the file.

Processing of supplementary files

- Electronic supplementary material will be published as received from the author without any conversion, editing, or reformatting.

Accessibility

In order to give people of all abilities and disabilities access to the content of your supplementary files, please make sure that

- The manuscript contains a descriptive caption for each supplementary material
- Video files do not contain anything that flashes more than three times per second (so that users prone to seizures caused by such effects are not put at risk)

INTEGRITY OF RESEARCH AND REPORTING

Ethical standards

Manuscripts submitted for publication must contain a declaration that the experiments comply with the current laws of the country in which they were performed. Please include this note in a separate section before the reference list.

Conflict of interest

Authors must indicate whether or not they have a financial relationship with the organization that sponsored the research. This note should be added in a separate section before the reference list.
If no conflict exists, authors should state: The authors declare that they have no conflict of interest.

Animal Welfare

If applicable, the author attests that experiments conducted on animal subjects complied with all applicable laws, regulations, and standards in the country where the studies were performed.

In general, it is expected that animal experimentation published in the International Journal of Legal Medicine complies with prevailing standards in either the European Union or the United States.

European Union standards

United States standards

AFTER ACCEPTANCE

Upon acceptance of your article you will receive a link to the special Author Query Application at Springer's web page where you can sign the Copyright Transfer Statement online and indicate whether you wish to order OpenChoice, offprints, or printing of figures in color.
Once the Author Query Application has been completed, your article will be processed and you will receive the proofs.

Open Choice

In addition to the normal publication process (whereby an article is submitted to the journal and access to that article is granted to customers who have purchased a subscription), Springer provides an alternative publishing option: Springer Open Choice. A Springer Open Choice article receives all the benefits of a regular subscription-based article, but in addition is made available publicly through Springer's online platform SpringerLink. We regret that Springer Open Choice cannot be ordered for published articles.

Springer Open Choice

Copyright transfer

Authors will be asked to transfer copyright of the article to the Publisher (or grant the Publisher exclusive publication and dissemination rights). This will ensure the widest possible protection and dissemination of information under copyright laws.
Open Choice articles do not require transfer of copyright as the copyright remains with the author. In opting for open access, they agree to the Springer Open Choice Licence.

Offprints

Offprints can be ordered by the corresponding author.

Color illustrations

Online publication of color illustrations is free of charge. For color in the print version, authors will be expected to make a contribution towards the extra costs.

Proof reading

The purpose of the proof is to check for typesetting or conversion errors and the completeness and accuracy of the text, tables and figures. Substantial changes in content, e.g., new results, corrected values, title and authorship, are not allowed without the approval of the Editor.
After online publication, further changes can only be made in the form of an Erratum, which will be hyperlinked to the article.

Online First

The article will be published online after receipt of the corrected proofs. This is the official first publication citable with the DOI. After release of the printed version, the paper can also be cited by issue and page numbers.

SCIENTIFIC STYLE

- Please always use internationally accepted signs and symbols for units, SI units.
- Genus and species names should be in italics.